

Chapter 4. Performance-Based Evaluation Process

At the core of the MoveAZ Plan evaluation process is an analysis of the system performance impacts of major capital projects on the Arizona transportation system. While the primary goal of this process is to guide, assess, and prioritize long-range transportation investments, several other important goals were identified by ADOT for incorporation. These included:

- **Building accountability and political support in the planning process by streamlining the management and associated decision-making about the allocation of resources for transportation investments.** Performance-based planning ensures accountability in decision-making, not only from the ADOT technical perspective, but also from the perspective of the Arizona Transportation Board.
- **Providing better, more accurate information to decision-makers with defensible, robust, and consistent analytical tools using system performance outcomes as the basis for identifying transportation investments.** This process provides ADOT and the Arizona Transportation Board with a rigorous technical method that prioritizes projects based on system performance impacts and benefits.
- **Providing a mechanism to monitor and track the success of transportation projects in meeting stated system performance goals and objectives.** Once projects are constructed and operational, this process provides ADOT and its Board with a mechanism to monitor the actual effects of performance on the transportation system. ADOT will then be able to refine and adjust the process to better meet transportation system performance goals.
- **Developing linkages between short- and long-range major capital project investments.** The initial MoveAZ Plan evaluation process provides ADOT with a list of prioritized capital projects that forms the basis of the State's long-range capital program. By 2010, this process will be integrated into both the short-range, Five-Year Capital Program and ADOT's planning to programming (including scoping) process.
- **Refining the methods used by ADOT to allocate resources among programs and capital projects and to potentially assess the tradeoffs of allocating funds by program and project area.** The process provides ADOT an opportunity to conduct tradeoff analysis to better utilize and allocate funds.

The MoveAZ Plan evaluation process involves identifying the expected future performance improvements of projects on the transportation system. The basic components of the process include:

- Identifying performance measures;
- Identifying projects and creating project bundles;
- Calculating system performance;
- Establishing thresholds to evaluate projects;
- Assessing project needs;
- Normalizing performance measures;
- Scoring performance factors; and
- Weighting performance factors.

Because the process was implemented with the understanding that all currently programmed projects (through 2008) would be built, programmed projects were not considered for evaluation. Each component of the MoveAZ Plan evaluation process is presented in the following sections.

■ 4.1 Identifying Performance Measures

Performance measures used to support the MoveAZ Plan were selected to identify and monitor system performance and gauge the ability of proposed projects to satisfy ADOT's goals. These goals can be described by the following performance factors:

- Mobility;
- Economic competitiveness;
- Connectivity;
- Preservation;
- Reliability;
- Safety;
- Accessibility; and
- Resource conservation.

Performance measures were organized according to the performance factors to which they apply (mobility and economic competitiveness were grouped together, as performance measures for those factors apply to both). Performance measures were identified, assessed, and finalized using input from the MoveAZ Steering Committee, MoveAZ

Working Group, and the MoveAZ Performance Measures and Factors input team. The measures are summarized below by performance factor.

Mobility and Economic Competitiveness

Mobility and economic competitiveness are captured by similar measures, because mobility is a key component to the economic well-being of Arizona. As Chapter 8 describes in greater detail, goods movement on the state transportation system is a major component of the State's economy. Providing for mobility will increase the economic competitiveness of the State.

These factors considered two measures:

1. Percent of person-miles traveled (PMT) by level of service (LOS); and
2. Average delay per trip.

Percent of PMT by LOS provides a broad systemwide perspective of how much travel is occurring under congested conditions. It also provides a visual representation of system conditions by different roadways (interstates and arterials) and areas (urban and rural). Average delay per trip measures the additional travel time the average traveler requires to reach a given destination. It measures mobility from the traveler's perspective, rather than from the systemwide perspective.

Connectivity

The following two connectivity measures consider the availability of efficient highway connections between Arizona cities and towns, particularly in more rural areas of the State:

1. Passing ability; and
2. Intercity travel time connectivity.

Passing ability identifies the ability to overtake slower moving vehicles on two-lane state highways. Passing ability is a function of sight distances, roadway grades, traffic volumes, and other related factors. Intercity travel time connectivity evaluates the circuitousness and travel time of existing state routes in the Arizona's high-priority corridors. The evaluation considers assessing the potential for travel time savings in these priority corridors associated with the project improvements.

Preservation

ADOT uses pavement and bridge management systems to determine future pavement and bridge conditions. As pavement and bridge maintenance and construction are

funded separately within ADOT, only the reconstruction need measure was computed in the MoveAZ Plan evaluation process. This measure can be updated by more detailed measures of pavement and bridge conditions as ADOT implements more advanced management systems. The preservation performance measures include:

- Reconstruction need;
- Pavement condition;
- Vehicle miles of travel (VMT) by pavement condition;
- Bridge condition; and
- Vehicle trips by bridge condition.

Reconstruction need assesses roadway segments requiring total reconstruction, with an average year of last reconstruction before 1970. This measure is used in the MoveAZ Plan to evaluate projects that improve deteriorating roadways, but do not affect roadway capacity.

The pavement condition and VMT by pavement condition measures rate the smoothness of state highway lane miles and associated vehicle movements on a scale from zero (“very poor”) to five (“excellent”). The bridge condition and vehicle trips by bridge condition measures identify the number or percentage of deficient bridges on state highways and the vehicular movements on those deficient bridges. A seven-point rating is used, with seven being excellent.

Reliability

Additional unexpected delay was examined to understand how incident-related delay (e.g., vehicular-related crashes, spills) and non-recurring delay (e.g., special events) impact vehicle movements and travel times on state roadways.

Safety

The safety performance factor includes two measures:

1. Crashes per million VMT by roadway type; and
2. Anticipated reduction in fatalities and injuries.

Crashes per million VMT identifies the likelihood that crashes will increase as the number of vehicles on Arizona’s roads increases. The anticipated reduction in fatalities and injuries identifies specific locations that have a high absolute number of crashes and the types of projects that could be implemented to reduce these crashes.

Accessibility

The following measures were used to examine accessibility by bus, bicycle, and HOV:

- Park-and-ride spaces;
- Bus turnouts; and
- Bike suitability.

The number of park-and-ride spaces helps determine access to the state transportation system for carpoolers and bus riders. The number of bus turnouts on state highways with transit or school bus service determines bus accessibility. Bike suitability considers the percent of state roadways suitable for bike usage based on ADOT definitions of bike suitability in the recently completed Bicycle/Pedestrian Plan. Existing roadways can often be made more suitable for bicycle travel without the need for costly new construction projects.

Resource Conservation

Resource conservation considers the following measures:

- Total mobile source emissions;
- Percentage of air quality improvement projects selected;
- Noise exposure;
- Projects listed in RTPs; and
- Fuel consumption.

Total mobile source emissions gauge systemwide environmental performance, as well as the environmental impact in areas where air quality is already a critical concern. Percentage of selected air quality improvement projects identifies air quality projects designed to reduce mobile source emissions. Noise exposure measures residential area exposure to transportation-related noise. Projects listed in RTPs examine the level of coordination between the MoveAZ Plan and regional plans in order to ensure that transportation decisions (and, indirectly, land-use decisions) are consistent across different tiers of government. Fuel consumption is a function of fleet fuel economy, as well as the specific projects ADOT chooses to build in the future.

■ 4.2 Identifying Projects and Creating Project Bundles

The 1994 ADOT long-range transportation plan identified 33 high-priority corridors for further evaluation. Since that time, ADOT has created at least one profile for each of these

major corridors. These profiles were prepared to analyze the transportation deficiencies and needs of a particular corridor, and to identify projects that could alleviate these deficiencies. ADOT also conducted small area transportation studies that focused on the short- and long-term transportation needs of smaller regions. The corridor profiles and the small area studies were a source of projects for MoveAZ Plan evaluations.

Another source of projects was the Vision 21 Plan, developed by the Governor's Office. Vision 21 included a major effort to identify all transportation needs in the State. The effort identified transportation needs from ADOT's corridor profiles and small area transportation studies, as well as regional and local transportation plans and studies. The resulting database of projects was merged with the projects described above to generate a list of proposed projects for consideration and evaluation in MoveAZ.

Because of its broad geographic scope and 20-year planning horizon, the MoveAZ Plan focuses only on large transportation projects. In contrast, ADOT corridor profiles and other studies cover a variety of both large and small projects. To ensure that the performance impacts of these projects were accurately measured, smaller projects were bundled together with appropriate large and small projects and analyzed in the MoveAZ Plan evaluation process.

As shown in Figure 4.1, ADOT has adopted a set of decision guidelines to bundle projects for evaluation. These guidelines are general rules of thumb intended to allow ADOT the flexibility to design bundles appropriate to the circumstances of a particular district or project type. These decision guidelines were applied to the available ADOT project list generated through corridor profile and other studies to develop the project bundles. These bundles were then reviewed and approved by ADOT planning staff and district engineers prior to full analysis in the MoveAZ Plan evaluation process. Bundles were not prepared in Maricopa County, because the MAG RTP identifies project needs in the MAG area and is incorporated by reference into MoveAZ (see page 3-7).

In addition to bundling projects for evaluation, cost estimates for the individual project elements of each bundle were checked for validity and consistency. Because corridor profiles and other studies were conducted over several years using numerous sources of financial data, there were inconsistencies in the cost estimates. A two-part process was used to develop consistent cost estimates. First, unit costs were estimated for types of projects from ADOT's corridor profiles. Project types included highway widening, interchange construction, bridge replacement, and others. Second, these "typical" unit cost estimates were compared to the original cost estimates in meetings with each of the ADOT district engineers to determine the appropriate cost for a particular project.

Figure 4.1 MoveAZ Plan Project “Bundling” Decision Guidelines

1. Small cost items within a widening project that are not part of a subprogram will be grouped with the widening.
2. Bridge and pavement preservation projects will be analyzed using management systems and not as capital projects.
 - a. Exception: If a bridge must be replaced due to a road widening or other project, then it will be included in the project bundles.
3. Short widening segments will be grouped together in a corridor if they are nearly adjacent (less than two miles apart).
4. Interchanges and bridge replacement projects will be grouped with widening (or other projects) whenever they overlap or are very close (within two miles).
 - a. Exception: If a corridor study specifies the interchanges or bridges to be altered as part of the widening project, only those interchanges or bridges within the project area will be included.
5. Projects on different roadways that are tightly aligned and have been planned together (according to existing sources) will be grouped as a single project. (Example: Widening projects in downtown Yuma on I-8, B-8, and SR 280.)
6. A group of similar projects that are more than two miles apart may be grouped together if they have been planned to address a single problem. (Example: Climbing lanes that are one to three miles apart.)
7. Total combined project costs will be kept within a reasonable range of about \$50 million. This serves as a guide only, not as a rule. For example, three widenings in a corridor at a cost of \$40 million each will be treated separately, rather than combined into a single \$120 million project.

Source: Cambridge Systematics, Inc., and ADOT, 2003.

■ 4.3 Calculating Project Performance

Fourteen specific system performance measures are shown in Table 4.1. Several measures presented in Section 4.1 could not be calculated to support the MoveAZ Plan evaluation process, because they lacked a natural baseline to measure against. These included bus turnouts, noise barriers, and consistency with regional transportation plans. Some preservation measures, primarily the bridge and pavement conditions measures, were also not used into the evaluation process, because pavement preservation and bridge maintenance work is funded through subprograms that use independent processes to evaluate the

performance benefits of particular projects. Though many of the projects analyzed by MoveAZ have an impact on pavement conditions (e.g., widening a highway over several miles typically includes resurfacing the entire highway over that segment, yielding overall improved pavement conditions), this impact is not captured intentionally. For the remainder of the discussion of performance measures, MoveAZ only addresses the reconstruction need measure. More detail on ADOT’s use of subprograms can be found in Chapter 6.

Table 4.1 MoveAZ System Performance Measures

Performance Factor	Performance Measures
Mobility and economic competitiveness	<ul style="list-style-type: none"> • Improvement in vehicle-to-capacity (V/C) ratio (weighted average by PMT) • Reduction in hours of delay
Connectivity	<ul style="list-style-type: none"> • Ability to pass in major two-lane corridors • Travel time improvement on ADOT high-priority corridors
Safety	<ul style="list-style-type: none"> • Improvement in crash rate (crashes per 100 million VMT) • Reduction in injuries
Preservation	<ul style="list-style-type: none"> • Reconstruction for older roads
Reliability	<ul style="list-style-type: none"> • Reduction in hours of incident-related delay
Accessibility	<ul style="list-style-type: none"> • Improvement in bike suitability (from Bicycle/Pedestrian Plan) • Added bus turnouts
Resource conservation	<ul style="list-style-type: none"> • Reduction in mobile source emissions • Reduction in fuel consumption • Added sound walls • Project consistency with local plans

Source: Cambridge Systematics, 2004.

The measures were calculated at the district level to determine the “district base performance.” These base performance values were calculated using the 2025 estimates of travel volumes for a given district. After calculating the district base performance, the performance for the districts was recalculated with the new project bundles to identify system performance impacts. This was referred to as the “district plus project performance scenario.” The improvement from the district base performance to the district plus project performance showed the performance gains that resulted from a particular project bundle. This process was repeated for each of the project bundles in each district to calculate the system performance.

■ 4.4 Establishing Thresholds to Evaluate Projects

The performance measures described in Section 4.3 provided a raw assessment of the estimated performance improvement that a given project bundle would produce. The MoveAZ Plan evaluation process also accounted for the “need” of a particular project bundle by applying upper and lower ranges to some performance measures. These threshold value ranges ensured that the transportation system improved by a project bundle included needs analysis. Project bundles above or below a particular threshold were unlikely to show a need for the particular improvement.

Thresholds were used for several of the performance measures to help ensure that the evaluation process captured the need for a given project, in addition to the performance improvement. Not all of the performance measures used thresholds. For example, the reduction in injuries was measured without a threshold, because each additional crash eliminated was as beneficial as the previous. Table 4.2 presents the thresholds used for each measure.

■ 4.5 Assessing Project Needs

A second method was used to account for the “need” of a particular project bundle. For several of the measures, the MoveAZ Plan evaluation process accounted for volume of traffic using the segments of roadway affected by the project. The performance improvement was multiplied by the project bundle average annual daily traffic (AADT) to generate this performance assessment.

There were several exceptions to this process. The delay and incident delay measures, which were calculated as hours of delay saved, were not multiplied by the project bundle AADT. Similarly, the number of injuries reduced by a project was already calculated using the project bundle AADT. Bike suitability, bus turnouts, noise barriers, and regional plan consistency also did not use the project bundle AADT.

Table 4.2 MoveAZ Performance Measure Thresholds

Performance Measure	Threshold
<i>Mobility and Economic Competitiveness</i>	
<ul style="list-style-type: none"> Improvement in V/C 	Uses existing ADOT standards: 0.71 for rural highway segments and 0.8 for urban highway segments. A segment that is already below the given threshold scores zero points; segments that are improved below the threshold value receive the portion of their improvement to the threshold.
<ul style="list-style-type: none"> Reduction in hours of delay 	Total delay for a given district in 2002. If a project reduces delay in a given district below the 2002 level, it receives that portion of the improvement down to the 2002 level.
<i>Connectivity</i>	
<ul style="list-style-type: none"> Ability to pass in major two-lane corridors 	One, the value at which AADT is equal to passing-lane weighted service volume. Improvements that reduce the ratio below one are scored only to this threshold.
<ul style="list-style-type: none"> Travel time improvement on ADOT high-priority corridors 	The 2002 travel time in the affected corridor. If a project reduces the travel time to below the 2002 level, it only receives that portion of the improvement to the 2002 level.
<i>Safety</i>	
<ul style="list-style-type: none"> Improvement in crash rate Reduction in injuries 	No threshold used.
<i>Preservation</i>	
<ul style="list-style-type: none"> Reconstruction need 	Road last reconstructed before 1970.
<i>Reliability</i>	
<ul style="list-style-type: none"> Reduction in hours of incident-related delay 	The total incident delay for a given district in 2002. If a project reduces incident delay below the 2002 level, it only receives that portion of the improvement to the 2002 level.
<i>Accessibility Factor</i>	
<ul style="list-style-type: none"> Improvement in bike suitability Added bus turnouts 	No threshold used.
<i>Resource Conservation Factor</i>	
<ul style="list-style-type: none"> Reduction in mobile source emissions 	The distribution of emissions rates is U-shaped, with peaks at low and high speeds. Projects score on this measure only if they reduce emissions.
<ul style="list-style-type: none"> Reduction in fuel consumption 	The distribution of fuel consumption rates is U-shaped, with peaks at low and high speeds. Projects score on this measure only if they reduce fuel consumption.
<ul style="list-style-type: none"> Added sound walls Project consistency with local plans 	No threshold used.

Source: Cambridge Systematics, Inc., 2004.

■ 4.6 Normalizing Performance Measures

To develop consistency in the measures, raw scores on each measure were converted into a normalized score between zero and 10 points. A zero score indicated that a given project bundle did nothing to improve a particular measure. The remaining points were assigned to project bundles relative to the scores of all project bundles analyzed for MoveAZ.

The scores were normalized on a 10-point scale, based on their position in the distribution of all project bundles on that score. This process is referred to as the percent rank. A project bundle with a score that was better than X percent of all project bundles on a given measure received a normalized score of $X/10$. For example,

- A project bundle that performed better than 80 percent of all other project bundles scored eight points;
- A project bundle that performed better than one-half of other projects scored five points;
- A project bundle that performed better than only 10 percent of other projects scored a single point; and
- A project bundle that provided no performance improvement scored zero point.

This method was applied to reduce the influence of outliers on the scoring method. If one or two projects performed much better on a given measure than all other projects, they would not skew the scale. For example, if the third best project scored better than 92 percent of all projects, it received 9.2 points, even if the performance score for the top two projects were substantially larger (i.e., double or greater) than the third best project.

■ 4.7 Scoring Performance Factors

Project bundles received a final score on each performance factor as a function of their score on one or more performance measures. Similar to the measures, each of the performance factors was also scored on a 10-point scale. The reliability factor had only one measure, so the factor score was the same as the measure score. For all other factors, multiple measures contributed to the factor score. For most factors, the final score was the average of the measures making up that score, with some exceptions. Table 4.3 describes the procedure for combining each set of measures into a single factor score.

Table 4.3 Performance Factor Scoring Methodology

Performance Factor	Measure Methodology
Mobility and economic competitiveness	Average of the two measures
Connectivity	Average of the two measures
Safety	Average of the two measures
Preservation	Single measure
Reliability	Single measure
Accessibility	Score of bike suitability measure, plus a single point for any added bus turnouts; maximum of 10 points
Resource conservation	Average of emissions and fuel consumption measures, plus a point each for a project with sound walls or a project that is consistent with local plans; maximum of 10 points

Source: Cambridge Systematics, Inc., 2004.

■ 4.8 Weighting Performance Factors

The final step in the MoveAZ Plan evaluation process was the application of performance weights to each of the factor scores to generate a total score for each project bundle. Weights provided a means to formalize the priorities of the long-range goals and performance factors of MoveAZ. The legislation directing ADOT to develop a long-range plan (House Bill 2660) also required a system of weights to be applied to the performance factors. A system of weights for each of the seven performance factors used in project analysis was developed through public and stakeholder involvement for the plan in coordination with existing ADOT policies and technical concerns.

Weighting Methodology

A three-step process was used to develop performance factor weights:

1. First, performance factors were identified;
2. Second, each factor received one of three descriptive weights that represented the relative priority assigned to that factor; and

3. Finally, each of the descriptive weights was assigned specific quantitative values that were then applied to the factor scores resulting from the evaluation process.

Three descriptive weights were selected to describe the relative priorities of the factors:

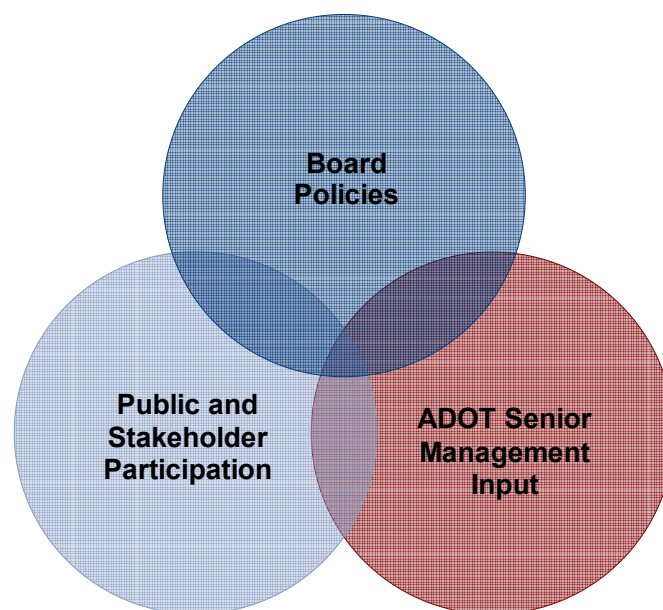
1. **Enhance** was used for factors with the highest priority for ADOT. These are factors that ADOT should focus on to improve roadway performance, possibly at the expense of other factors.
2. **Sustain** was used for factors for which ADOT should try to maintain current performance levels.
3. **Neutral** was used for all other factors. These factors represent issues that are important, but somewhat less so than other factors.

During the evaluation process, the descriptive weight categories were translated into numerical weights. The final weights were subject to extensive sensitivity testing during the planning process.

Sources for Weights

The major sources used to develop the performance factor weights are described below and shown in Figure 4.2:

- **Currently adopted board policies.** The Arizona Transportation Board policy document describes the current vision and commitments that the Board makes for transportation in Arizona. It also outlines a set of policies to help meet these commitments.
- **Public input conducted as part of the MoveAZ planning process.** MoveAZ included three phases of public and stakeholder involvement. Through focus groups and regional forums, members of the public were able to help shape the MoveAZ strategic direction. MoveAZ included an analysis of comments made at all of these public events, as well as through previous planning processes.
- **Consistency with departmental goals.** The MoveAZ Continuity Team is an internal ADOT committee consisting of representatives of ADOT's major divisions. This group provided guidance on the selection of weights to ensure that the weights fit with existing departmental goals.

Figure 4.2 Sources of MoveAZ Factor Weights

MoveAZ Descriptive Weights

Overall, each of the performance factors received support at all of the regional public forums and in the Arizona Transportation Board policy statement. During the intermediate partnering phase of the MoveAZ Plan, participants were asked to select the most important key findings from the initial phase. Across all of the forums, each of the key findings received nearly the same level of support.

Enhance

- **Mobility and economic competitiveness** is one of the primary goals of both ADOT and the traveling public. Consultation with ADOT staff and public partnering events revealed that mobility is consistently a high-priority issue. For example, participants at the regional public forums cited concerns and strategies related to mobility more frequently than all other performance factors during both the initial and intermediate partnering events.
- **Safety** is extremely important to ADOT, various Federal agencies, and the traveling public. ADOT is committed to reducing crashes involving motor vehicles and making the roads safer for all users. In public partnering sessions, safety was consistently raised as an issue. For these reasons, safety received an enhance rating.

Sustain

- **Accessibility** or providing access to the transportation system for users is an important goal for ADOT. This goal received relatively strong support during the public partnering events. It was also consistent with ADOT policy to develop a multimodal transportation system that provides opportunities for all Arizonans to use the transportation system.
- **Preservation** or investing in the maintenance of the transportation system is important to ADOT and Arizonans alike. Pavement condition in Arizona is substantially better than for the U.S. as a whole. This commitment to preservation was supported by participants at public partnering events. Because the quality of maintenance is already quite high, this factor receives a sustain, instead of an enhance.

Neutral

- **Resource conservation**, as with all of the other factors, is an important goal for ADOT. Compared to some of the issues raised by other factors, however, resource conservation is somewhat less important. Providing for travel mobility and improving roadway safety form the core of ADOT policy. Similarly, public partnering sessions were less likely to point to resource conservation issues. For these reasons, the resource conservation factor receives a neutral rating.
- **Reliability** taps the public's desire for predictability of travel. As a growing state with a rapidly growing transportation system, reliability concerns are somewhat less important than overall mobility. As the Arizona transportation system matures, however, reliability concerns will likely grow. For the MoveAZ Plan, reliability received a neutral rating.
- **Connectivity** is a goal supported by ADOT and at the MoveAZ public partnering sessions. Again, however, it received overall less support than other related issues. Connectivity is closely related to other issues, such as mobility and accessibility. But where these issues received substantial public support, the support for connectivity was much more varied. Connectivity received relatively less support across all of the forums, compared to other performance factors. This strategy, therefore, was weighted as neutral, because it is important, but not more so than other strategies.

MoveAZ Numeric Weights

The final set of weights developed for the MoveAZ performance factors was based on consultations with the ADOT advisory bodies and detailed sensitivity analyses. The objective of using weights in the evaluation process was to provide additional support to projects that perform well on higher-priority factors, such as safety and mobility. However, ADOT recognized that each performance factor is important for the transportation system. Weights were not intended to cause a radical redistribution of performance to

projects. As a result, the weights shown in Table 4.4 provide a moderate boost to project bundles that improve mobility, safety, accessibility, and preservation.

Table 4.4 Performance Factors Weights

Performance Factor	Weight
Mobility	1.4
Reliability	1.0
Connectivity	1.0
Accessibility	1.2
Safety	1.4
Preservation	1.2
Resource Conservation	1.0

Source: Cambridge Systematics, Inc., 2004.